FSIS FACTS

Bacteria That Cause Foodborne Illness

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(Supersedes "Preventable Foodborne Illness", FSIS-34, Slightly Revised May 1989)

United States Department of Agriculture

Food Safety and Inspection Service

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Foodborne illness is a worldwide problem, in developed and developing nations alike. Reports show that U.S. foodborne illness causes thousands of individual cases, hundreds of outbreaks, and several deaths each year. However, 6.5 to 81 million Americans may actually suffer its symptoms each year.

The U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) inspects slaughtering and processing of domestic food animals, to assure the safety of the meat and poultry supply. Because education is a key control measure for certain types of foodborne illness, FSIS also conducts extensive preventive education programs for consumers and other food handlers.

Health Effects

The unpleasant symptoms of a "simple" case of foodborne illness may require absence from school, work, or leisure activities while the illness runs its course.

However, health consequences can be more severe. Diarrhea and resulting dehydration may require hospitalization, and diarrhea can lead to temporary or permanent arthritic conditions in some people. Bacteria can invade the blood (septicemia) or the membranes of the brain and spinal cord (meningitis). At worst, the human costs include death and grief.

Some people are more vulnerable than others. The very young and the very old are generally most at risk. Others at high risk include those with underlying health problems and the malnourished. Genetic differences may make some persons more susceptible than others. For certain types of infections, chronic antibiotic use or pregnancy may be a risk factor.

A strong immune system plays an important role in limiting the progression of illness. Infants have incompletely developed immune systems. AIDS, cancer, and kidney patients are among those with suppressed immune systems. The number of Americans in these high-risk categories is increasing, and preventing "preventable" foodborne illness has become imperative.

Bacterial Foodborne Illnesses

The most commonly reported foodborne illnesses are caused by bacteria. Ironically, these are also the easiest types of foodborne illness to prevent — *by thoroughly cooking foods to destroy bacteria, keeping raw and cooked foods separate, and refrigerating cooked foods promptly in shallow containers.*

Of all foodborne illnesses, those caused by bacteria are the most common-- and the most preventable.

FSIS is particularly concerned with educating food handlers about the following preventable bacterial illnesses frequently associated with meat or poultry. (The numbers reflect all food vehicles, not just meat and poultry.)

Preventable Bacterial Foodborne Illnesses 1973-1984

Illness Caused by	Bacteria	Outbreaks*	Cases	Deaths	Deaths per 1,000 Cases
Salmonellosis	*Salmonella*	597	30,296	60	2.0
Campylobacteriosis**	*Campylobacter jejuni*	45	6,441	2	1.6
Clostridium perfringens enteritis	*Clostridium perfringens*	214	12,432	12	1.0
Staph Intoxication	*Staphylococcus aureus*	358	17,332	4	0.2
Botulism	*Clostridium botulinum*	183	428	37	86.5

Except for botulism, an outbreak usually affects at least 2 persons. ** For the period 1978-86 only. Source: CDC

Salmonellosis is a significant foodborne illness, worldwide. A 1985 U.S. outbreak associated with pasteurized milk caused at least 16,000 cases and several deaths. In addition to outbreaks, about 40,000 sporadic cases are reported each year.

Salmonella infections occur when a person ingests live Salmonella bacteria, which then survive digestion and reproduce in the small intestine to numbers large enough to cause symptoms. There is no precise infective dose, although some strains are more virulent than others. Healthy adult volunteers have consumed millions of Salmonellae without getting sick. Others have gotten sick from as few as 10 bacteria in their food.

Symptoms: Stomach pain, usually diarrhea, and often nausea, chills, fever, or headache, within 6 to 48 hours after food was eaten; and lasting 3 to 5 days. Infants and elderly are at greatest risk, but anyone can be infected.

Bacteria found: Most raw foods of animal origin assumed to be contaminated. Salmonella are also found in the feces and intestinal tracts of dogs, cats, rodents, and certain turtles and wild animals.

Processed foods that might be eaten without further preparation (ready-to-eat) are not permitted to contain Salmonella.

Characteristics of bacteria: Certain strains of Salmonella cause illness in both humans and animals; others affect only humans. Ten strains of Salmonella bacteria cause most reported human infections. One of today's most common strains, *Salmonella enteritidis*, has been linked to Grade A shell eggs, and scientists are studying the possibility that hens carrying the bacteria may transfer bacteria to some eggs during ovulation. Although for many years experts believed that Salmonella could not be eliminated from the environment, government and industry are now researching practical ways to reduce the prevalence of certain strains and minimize their spread through the food chain.

Major food vehicles, 1977-84: Beef (particularly roast beef), turkey, pork, chicken, ice cream made with unpasteurized eggs, poultry salads, eggs, milk (raw), Mexican foods, potato salad, baked goods, macaroni and cheese.

Control: Thorough cooking destroys Salmonella bacteria. Another essential control measure is to avoid contaminating other foods with juices from raw meat or poultry via counters, utensils, hands, or serving plates.

A Look at the Problem

The Centers for Disease Control (CDC) in Atlanta, Georgia, collects, analyzes, and disseminates information on foodborne illness as voluntarily reported by State and local health officials, the Food and Drug Administration (FDA), and the U.S. Department of Agriculture. CDC also studies certain outbreaks and foodborne illnesses in depth. This type of information is called epidemiological data.

Food Known, Agent Known, Causes Known

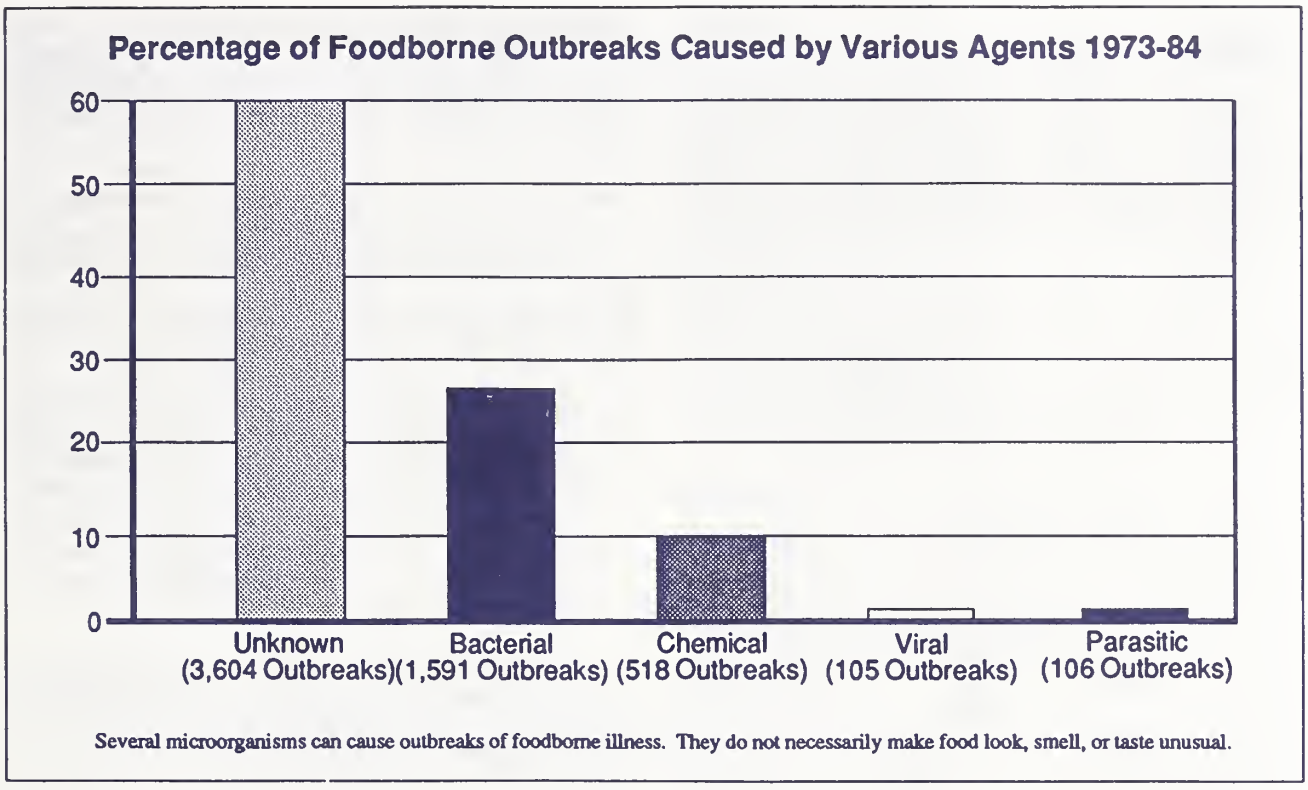
Epidemiological data cannot accurately summarize the extent of foodborne illness. CDC notes that outbreak reports represent "only a small fraction of the total number that occur." There are many reasons, including:

-The varying priority State and local health departments assign to foodborne illness and to inspection of restaurants and retail outlets. They also have varying investigative and laboratory capabilities.

-The "invisibility" of outbreaks. Outbreaks that affect many people, lead to hospitalizations and deaths, are associated with a restaurant, or are associated with a short incubation period are more likely to be noticed.

-The lack of rapid and reliable analytical methods to detect some pathogens in food or human blood or stools.

Nevertheless, epidemiological data provide important insights into the causes of foodborne disease, thus helping in control and prevention.



Several microorganisms can cause outbreaks of foodborne illness. They do not necessarily make food look, smell, or taste unusual.

Campylobacteriosis has long caused animal disease but was first recognized as a human illness in the 1970's and has been reportable to CDC only since 1978. Some experts believe campylobacteriosis is more common than salmonellosis.

Most cases of campylobacteriosis are caused by *Campylobacter jejuni* and occur after live bacteria are ingested. (Person-to-person transmission appears to be uncommon.) Studies with volunteers and examinations of outbreaks suggest that only a few hundred cells of *Campylobacter jejuni* may be necessary to cause illness.

Symptoms: Fever, headache, and muscle pain, followed by diarrhea (sometimes containing blood), abdominal pain, and nausea; within 2 to 10 days after food is eaten, usually lasting 1 to 10 days. Complications can include meningitis, urinary tract infection, and reactive arthritis. Persons of any age may contract the infection, but the bacteria is most often isolated from infants and adults in their twenties. Until age 45, males are more vulnerable.

Bacteria found: Common on purchased raw poultry. Also common in intestinal tracts of chickens, turkeys, cattle, swine, sheep, dogs, cats, rodents, monkeys, some wild birds, and some asymptomatic humans. Have been found in water, soil, and sewage sludge.

Characteristics of bacteria: Prefer low-oxygen environments, and will survive longer in foods at refrigeration temperatures than at room temperatures. *C. jejuni* are fragile and do not grow well in the presence of harmless bacteria usually found on raw food.

Major food vehicles: In outbreaks, raw milk, poultry, eggs (1978-86). Number of reported outbreaks tends to peak in May and October. Campylobacter-contaminated water has caused outbreaks affecting thousands. In sporadic cases, poultry (1982 to present). Number of reported sporadic cases tends to peak in midsummer.

Control: Avoid raw milk and untreated water. Cook meat and poultry thoroughly to destroy any bacteria that may be present. Practice good personal hygiene and kitchen sanitation to prevent possible recontamination of cooked food by bacteria in human feces. Thorough handwashing with soap and a fingernail brush is strongly advised.

Agents of Illness

Bacteria are microscopic organisms. Some bacteria are beneficial and are even used in food processing. Others combat disease. However, *seven specific bacteria caused 26 percent of all foodborne outbreaks reported between 1973 and 1984*, accounting for 43 percent of cases and 75 percent of deaths in those outbreaks.

Unknown microbiological agents caused more than half of outbreaks —including 84,946 cases and 25 deaths— between 1973 and 1984. The agent of illness may never be identified if there is no detection test, if laboratory investigation is incomplete, or if the agent is not known to cause foodborne illness.

Chemical agents such as scombrotoxin, ciguatoxin (associated with seafood), and other "natural" toxins formed in food caused 3,542 cases and 19 deaths in outbreaks between 1973 and 1984. Chemical foodborne illnesses are among the most deadly; 5.4 of every 1,000 victims will die. Food handler intervention can prevent some chemical outbreaks, but not all. For example, prompt refrigeration can prevent the formation of scombrotoxin in certain fish, but thorough heating does not always destroy toxins.

Viruses, microorganisms too small to be seen with an ordinary microscope, grow or reproduce only in living cells. They are often found in untreated water or sewage-contaminated water, and viruses from human feces on inadequately washed hands can infect others via food. Viruses such as the Norwalk virus and Hepatitis A virus caused 8,425 cases and 2 deaths in outbreaks between 1973 and 1984. One outbreak involved 3,000 persons. For this reason, foodborne viruses are of increasing concern to the public health community. Normal cooking may lower the risk of illness but may not destroy all viruses.

Parasites require nutrients from their host to complete their life cycle. Parasites caused 795 reported cases and 4 deaths in outbreaks between 1974 and 1983. About 5 of every 1,000 persons who contracts a parasitic foodborne illness can be expected to die from it, so continued public health vigilance is warranted.

Thorough cooking destroys larvae of parasites such as *Trichinella spiralis*, preventing them from completing their life cycle in human hosts. Human cases of trichinosis appear to be on the decline. They are always associated with raw or undercooked meat, including pork (particularly pork sausage), bear meat, and other meat. The presence of *Trichinella spiralis* in swine has been greatly decreased, in part by outlawing the feeding of uncooked garbage. Scientists are studying the prevalence of *Toxoplasma gondii* in swine. Toxoplasmosis is a particular risk for pregnant women, who are urged to let someone else change the cat litter box.

***Clostridium Perfringens* Enteritis** is a well-known foodborne illness caused by a toxin of *Clostridium perfringens* Type A. The toxin is usually formed in the body, but evidence shows it may sometimes form in food.

Symptoms: Diarrhea and gas pains, rarely vomiting or fever; within 9 to 15 hours after millions of vegetative cells are ingested in food, and lasting about a day.

Bacteria found: Present in soil, sewage, dust, and the intestinal tracts of most animals and humans.

Characteristics of bacteria: Require anaerobic, or oxygen-free conditions for growth. Under the right conditions, they grow very rapidly; a few thousand bacteria can reproduce to 1 million within an hour. Vegetative bacterial cells are easily killed by normal cooking, but dormant spores can survive. Bacterial cells cannot reproduce at recommended refrigeration temperatures of 40 degrees F or below.

Major food vehicles, 1977-84: Improperly prepared roast beef, turkey, Mexican food (including tacos, enchiladas, and beans), other meat dishes, pork, chicken, and cooked ground meat.

Control: Keep cooked foods above 140 degrees F during serving. Thorough cooking, rapid and even cooling, and thorough reheating are also necessary to destroy this bacteria or prevent its growth.

***Staphylococcus Aureus* Intoxication**, one of the most common foodborne illnesses, occurs when *S. aureus* bacteria multiply and form toxin in cooked food that is high in protein. One million or more cells per gram of food usually produces enough toxin to cause illness.

Symptoms: Abdominal pain or nausea, followed by vomiting and often diarrhea; occasionally, fever (or subnormal temperature), chills, headache, weakness, and dizziness. Symptoms occur within 30 minutes to 8 hours after food consumption, usually within 2 to 4 hours). Recovery requires a day or two. Although this illness is considered mild, it has caused deaths.

Bacteria found: Common on animal hides; also skin, noses, and throats of more than 50 percent of healthy people. Bacteria also common in infected cuts, pimples, and acne; may be exhaled during talking, coughing, and sneezing.

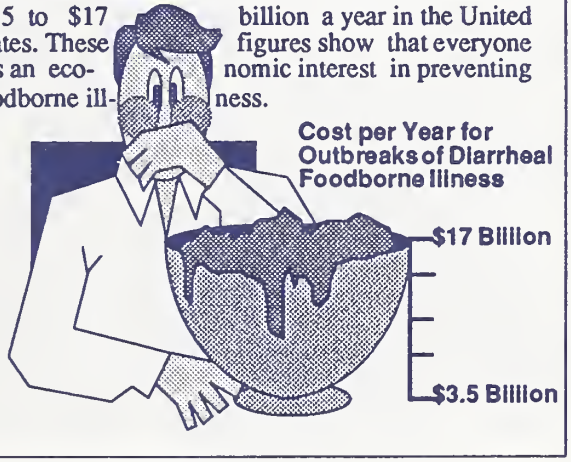
Characteristics of bacteria: Bacteria do not form spores. Prefer cooked food high in protein. Also grow well in foods high in sugar or salt, which inhibit growth of more sensitive organisms.

Major food vehicles, 1977-84: Ham (28.6 percent), turkey, chicken, pork, roast beef, chicken and turkey salads, potato salad, cream-filled pastry, other meats, other salads (crab, macaroni, tuna), eggs and egg salad, custard, luncheon meats and hot dogs, and Mexican foods. Outbreaks are reported year-round, but outbreak reports tend to peak in August.

Control: Prompt refrigeration of cooked food in shallow, covered containers prevents the proliferation of bacteria and the formation of toxin. Thorough cooking destroys bacterial cells, but the toxin is resistant to heat, refrigeration, freezing, and chemicals such as nitrite. Because humans carry the bacteria and because the bacteria can multiply at room temperature to form toxin, it is particularly important to avoid recontaminating cooked food at serving, and to avoid leaving it at room temperature for extended periods.

Economic Effects

The costs of foodborne illness include medical care, lost wages, public health investigation, lost business, and, increasingly, legal action. An investigator who studied 17 foodborne outbreaks in the United States, Canada, and other countries, found an average cost of almost $200,000 per outbreak. In some cases, entire industries were crippled. Others have estimated that diarrheal foodborne illness costs from $3.5 to $17 billion a year in the United States. These figures show that everyone has an economic interest in preventing foodborne illness.



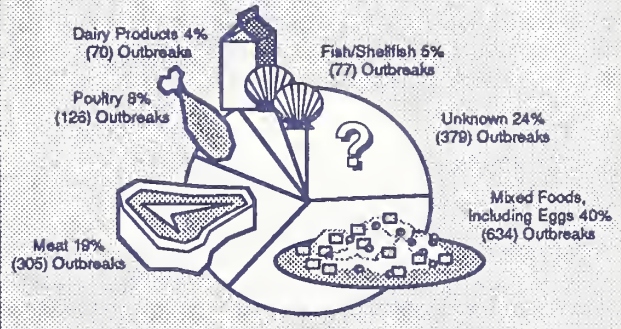
Food Vehicles in Outbreaks.

Under the right conditions, almost any food can be a vehicle for microbiological agents that cause illness.

A study of all foodborne illness outbreaks between 1977 and 1984 in which the food vehicle was successfully identified found that the most frequently implicated foods were:

1. **Seafood** (Raw clams)
2. **Meat** (Roast beef, ham)
3. **Poultry** (Turkey, chicken)
4. **Salads** (potato, chicken)
5. **Chinese food** (Fried rice)
6. **Mexican-style food** (Beans, meat)

The chart shows the types of food vehicles involved in bacterial foodborne illness outbreaks between 1973 and 1984.



Food vehicles in bacterial outbreaks. High-protein foods of animal origin — meat, poultry, fish and shellfish, dairy, and egg products — are particularly likely to be the food vehicles for bacterial outbreaks. This is why FSIS is concerned about educating food handlers on practices that will prevent bacterial foodborne illness.

However, improperly handled vegetables such as potatoes, onions, pinto beans, tofu, and coleslaw also have been confirmed as vehicles in recent outbreaks of bacterial foodborne illness.

Botulism. Meat and poultry products are infrequently associated with botulism, but it is one of the most deadly foodborne illnesses. (The following discussion does not address infant botulism or wound botulism.) Foodborne botulism is caused by ingestion of *Clostridium botulinum* neurotoxin in food. The neurotoxin is formed when heat-resistant, dormant spores of *C. botulinum* Type A, B, E, or F survive and germinate during storage, usually at temperatures above 38 degrees F.

Symptoms: Initially, dry mouth, double vision, difficulty in focusing on a near point, and difficulty swallowing. Many victims also suffer from nausea, vomiting, abdominal cramps, diarrhea, sore throat, or dizziness. Later, constipation, weakness, muscle paralysis, and difficulty breathing occur. Symptoms usually occur 12 to 48 hours after consumption, but may start 8 days later, and last 1 to 10 days. Treatment includes antitoxins and supportive care, including a respirator.

Bacteria found: Everywhere, including rotting vegetation; soil from farms, forests, the bottoms of streams, lakes, and coastal waters; crabs and shellfish; feces and carcasses of birds and animals; even autopsy specimens.

Characteristics of bacteria: Types A, B, and F are a concern in low-acid canned foods. Type E is a concern in pasteurized or unheated foods. Types vary in tolerance to salt, water activity, minimum temperature required for growth. In general, toxins are most likely to form in high-moisture, low-salt, low-acid foods devoid of oxygen and stored above 38 degrees F.

Major food vehicles, 1977-84: Peppers and pepper sauce, asparagus, beans (green, lima, salad, soy), salmon and fish eggs, tomatoes and tomato juice, beets, improperly fermented fish, pickles/relish, and baked potatoes and potato salad. Foil-wrapped baked potatoes, left for days at room temperature and then made into potato salad, have been vehicles, as have onions covered in butter and held on a warm range all day. Meat loaf, pot pies, and stew left at room temperature or in unheated ovens overnight have also been botulism vehicles.

Control: Outbreaks are rarely associated with commercial products. Thorough heat processing, nitrite and salt, acidification, and proper drying are used to prevent botulism from processed products.

Home canners should follow established guides for canning. Boil low-acid home-canned foods (for example, green beans) for 10 minutes. Do not taste food from leaking, bulging, or damaged cans; from cracked jars or jars with loose or bulging lids; from containers that spurt liquid when opened; or any canned food that has an abnormal odor or appearance.

Refrigerate cooked foods in covered, shallow containers within 2 hours after serving. Ensure that steam tables keep cooked foods above 140 degrees F during serving. Reheat refrigerated foods thoroughly before serving or eating.

Generalizations?

Most bacterial cells are destroyed by thorough cooking. Beyond that, it is difficult to make generalizations about bacteria. Most bacterial cells prefer warmth and neutral pH conditions, but will survive in the refrigerator and freezer; a few grow at refrigerator temperatures. Bacteria have varying resistance to salt, but most do not survive in foods with relatively high salt concentrations.

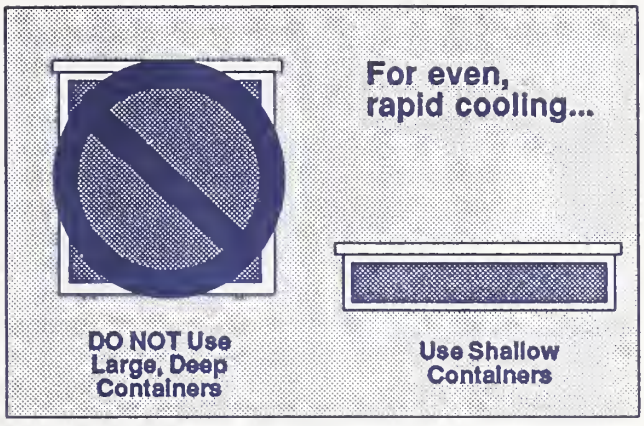
Some bacteria form toxins, others do not. Those that form toxins generally have a dormant, spore stage. Spores are harmless unless the right conditions encourage them to enter the reproductive stage. Many spores can survive the heat of cooking and are unaffected by freezing or drying. Bacterial toxins have varying resistance to heat; some can even survive boiling.

Infections occur from the ingestion of "enough" live bacterial cells that have reproduced in food, have reproduced in the small intestine, or both. The virulence of the bacteria and the resistance of the victim, as well as the number of bacterial cells that have survived the hydrochloric acid of digestion, determine severity of infection.

Some foodborne bacterial illnesses are infections, and others are intoxications.

Intoxications are the effects of a toxin formed by reproductive bacterial cells in food or in the human body. The severity of the intoxication is determined by the type of toxin and the amount. The amount of toxin is directly proportional to the number of bacteria.

Preventing the Preventable. *The most common errors in foodborne illness outbreaks are leaving foods at room temperature too long and refrigerating foods in large, deep containers that cool too slowly.* In outbreaks associated with meat and poultry, common food-handling errors are: leaving cooked foods at room temperature too long, undercooking, and failing to reheat cooked foods thoroughly. In many outbreaks, more than one of those errors may be made, compounding the risks of illness. □



New Concerns

The following bacterial illnesses have been recognized as human foodborne illnesses only in the last 9 to 18 years. The most striking fact about these diseases is that they are caused by pathogenic bacteria which can grow slowly at refrigeration temperatures formerly thought to be safe. (Like other bacteria, the "cold-loving" bacteria survive freezing but are generally destroyed by thorough cooking.) Nevertheless, refrigeration at 40 degrees F or colder remains essential to minimize opportunities for bacterial growth.

Hemorrhagic Colitis. Several strains of *Escherichia coli* bacteria, frequently associated with fecally contaminated water, have long been known to cause diarrhea in infants and travelers. However, in 1982, it was first recognized that a specific new serotype of *E. coli* could cause hemorrhagic colitis. In that year, two outbreaks occurred, both associated with undercooked hamburger.

A toxin of the serotype *E. coli* 0157:H7 causes the disease. Most often, the toxin probably forms in the intestinal tract after an unknown number of the bacteria are ingested, but some speculate the toxin may also form in food. Person-to-person transmission also appears to be possible.

Symptoms: Severe abdominal cramps, followed by diarrhea (often bloody); often vomiting and nausea; occasionally a low-grade fever. A possible complication is hemolytic uremic syndrome (HUS), a urinary tract infection that is a leading cause of acute kidney failure in children. Since the first outbreaks, CDC has studied sporadic cases to learn more about the disease. Symptoms generally begin about 3-4 days after the food was eaten, last up to 10 days, and often require hospitalization. Because the microorganism passes through the human body very quickly, physicians are advised to freeze a portion of each suspect stool sample so that analysis for *E. coli* 0157:H7 can be conducted if Salmonella and other suspect pathogens are ruled out.

Bacteria found: In isolated samples of pork, poultry, raw ground beef, and lamb. FSIS is sampling both raw and cooked products for the bacteria, to learn more about its prevalence in animals and the environment.

Characteristics of bacteria: Easily destroyed by heat, but grows slowly at temperatures of 44 degrees F and above.

Major food vehicles: Ground beef and unpasteurized milk have been involved in some illnesses, but food vehicle not always confirmed. A 1988 outbreak in Minnesota is believed to have been associated with precooked beef patties which had been undercooked in processing, then thawed at room temperature and reheated incompletely. (*E. coli* 0157:H7 were never isolated in the product.)

Control: Thorough cooking and reheating, good sanitation, and refrigeration at 40 degrees F or below are all important.

Listeriosis. Infection caused by *Listeria monocytogenes* was recognized as a human foodborne illness after a 1981 Canadian outbreak traced to contaminated coleslaw — made from cabbage grown in soil fertilized with manure from Listeria-infected sheep. A 1985 California outbreak involving a soft cheese caused spontaneous abortions, 40 deaths, and about 100 illnesses.

Foodborne listeriosis has been reportable to CDC since 1985. As many as 1,600 cases and 415 listeriosis deaths may occur annually. The average death rate is 200 to 300 cases per 1,000 (a higher death rate than for botulism).

Symptoms: In adults, sudden onset of flu-like symptoms including fever, chills, headache, backache, and sometimes abdominal pain and diarrhea. In newborns, respiratory distress, refusal to drink, vomiting, early discharge of meconium, and skin nodules in the throat or on the back. Pregnant women are likely to suffer painful, short-term effects. However, fetuses and newborns are at greatest risk; listeriosis can cause spontaneous abortions and stillbirths in humans, as it does in sheep and other animals. Surviving newborns are likely to contract meningitis or other complications. The elderly with underlying health problems are most likely to die from meningitis or other complications. However, cancer, AIDS, cirrhosis, kidney dialysis patients, and others are also considered at greater risk for contracting listeriosis.

Bacteria found: Common in the feces of asymptomatic humans and animals, cow and human milk, improperly fermented silage, leafy vegetables, soil, and food processing environments. Have been cultured in soft-ripened and pasteurized cheeses, ice cream, raw meat and processed meat, raw and cooked seafood, and vegetables, including pre-cut and packaged vegetables.

Characteristics of bacteria: In some foods, the population of *L. monocytogenes* will double in 1.5 days at a temperature of 39.2 degrees F. They are relatively resistant to salt and heat, but post-processing contamination rather than failure of heating or pasteurizing processes is usually suspected when the bacteria are detected on processed products.

Food vehicles: Cabbage, soft cheese, turkey frankfurter. Because of the gravity of the disease, FSIS has developed a test and is monitoring for the bacteria in both raw and processed, ready-to-eat products. Laboratory-verified findings of *L. monocytogenes* in ready-to-eat products warrant a recall.

Control: Avoid raw milk, and cheese made from unpasteurized milk. Pregnant women and other high-risk groups are advised to carefully observe "keep refrigerated" and "sell by" and "use by" dates on processed products, and to thoroughly reheat frozen or refrigerated processed meat and poultry products before consumption.

Yersiniosis. Foodborne yersiniosis infection is caused by ingestion of an unknown number of *Yersinia enterocolitica* bacteria. Strains 03, 08, and 09 are believed to cause most human yersiniosis in the United States. (The bacteria are difficult to culture in human stools, so the disease is believed to be underreported.) An infected person can infect others. Although the Yersinia species were well known, the link to foodborne illness first became apparent in a 1972 Japanese outbreak. The first U.S. outbreak in 1976 was associated with chocolate milk.

Symptoms: Abdominal pain (in the lower right quadrant, mimicking appendicitis), fever, and diarrhea (often bloody); sometimes vomiting. Symptoms occur within 1 to 7 days after ingestion, often lasting 1 to 2 days. Children are most at risk for contracting yersiniosis. Many appendixes later shown to be healthy have been removed in documented cases and outbreaks of yersiniosis.

Possible complications include arthritic or anemic conditions, thyroid disease, acute carditis that resembles rheumatic fever, and occasionally meningitis. The aged, those with immune deficiencies or suppressed immune systems, and cirrhosis patients are most at risk for complications. Yersiniosis is rarely fatal.

Bacteria found: Common in swine and swine waste. Have been isolated in deer, raccoons, geese, hares, chinchillas, cattle, chickens, horses, dogs, cats, and rats. Have been isolated in unchlorinated water in wells, lakes, rivers, and streams; and in fresh and vacuum-packaged pork and beef, poultry, raw and pasteurized milk, ice cream, mussels, oysters, shrimp, fish, fruit, and vegetables.

Characteristics of bacteria: The bacteria form toxin, but the relationship of the toxin to the illness is still being studied. A few hundred cells in raw pork multiplied to millions per gram during 10 days of refrigeration at 44.5 degrees F.

Major food vehicles: Chocolate milk, milk, other dairy products, mussels, tofu, oysters, and contaminated water. Swine waste has been implicated in some outbreaks.

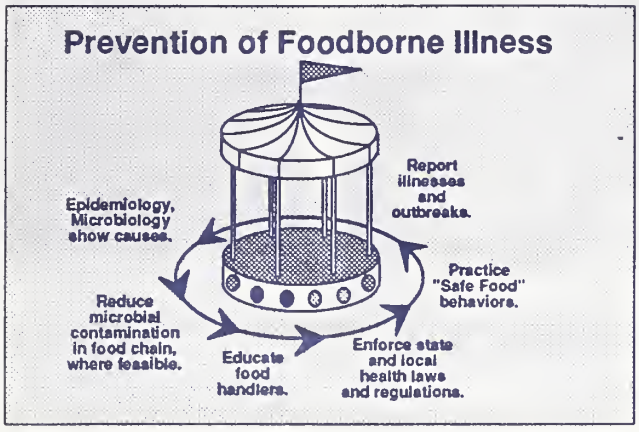
Control: Thorough cooking and reheating are essential control measures, along with sanitation and personal hygiene. □

Cause and Effect

At least four factors are necessary for bacterial foodborne illness to occur:

- -Bacterial cells or spores;
- -A food vehicle;
- -Conditions allowing bacteria to survive, reproduce, or form toxin;
- -A vulnerable food consumer who ingests enough of the agent.

Theoretically, intervention at any one of these points can prevent illness. Practically speaking, it is not possible to eliminate all bacteria from the environment, to give up all foods (since any food can be a vehicle), or to "vaccinate" all vulnerable people against illness (since any person may be vulnerable under the right conditions). ***Therefore, good food-handling practices remain the last, best defense against bacterial foodborne illness.*** □



Suggestions for Further Reading:

Risks Associated with Vehicles of Foodborne Pathogens and Toxins.
Frank L. Bryan, in **Journal of Food Protection** (Volume 51, Number 6), June 1988.

Risks of Practices, Procedures and Processes that Lead to Outbreaks of Foodborne Diseases.
Frank L. Bryan, in **Journal of Food Protection** (Volume 51, Number 8), August 1988.

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H & G Bulletin 247. Preventing Foodborne Illness. 1990.
A 24-page booklet designed for professionals interested in food safety. Explains how to prevent foodborne illness by following key food safety guidelines when shopping for, storing, preparing and serving food. Identifies the bacteria that most often cause foodborne illness. **Limit 1 copy.**

☐ *NEW!*

FSIS-39. People, the Public Health and Consumer Protection. 1990.
Tells how FSIS ensures that America's meat and poultry supply is safe, wholesome and accurately labeled. It explains the inspection process, basic labeling requirements, inspection of imported products and enforcement of safety requirements once meat and poultry leave the plant. **Limit 1 copy**

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Salmonella and Food Safety. 1988.
A four-page backgrounder in question and answer format about Salmonella, including the "strategy" to take to avoid this food poisoning bacteria.

Preventing Preventable Foodborne Illness

To prevent "preventable" foodborne illness, the following basic practices should be followed by all food handlers — those in homes, restaurants, retail stores, institutions, church picnics — anywhere food is served. If these practices are not followed, the risk of illness increases.

Read and follow label instructions to "keep refrigerated" and "use by" a certain date.

Wash hands with soap and water for 20 seconds before handling food or food utensils, and after handling raw meat or poultry. Use a fingernail brush.

Separate the raw and the cooked: Do not let juices from raw meat or poultry come in contact with other foods, surfaces, utensils, or serving plates. At the grocery store, place individual packages of meat or poultry in plastic bags, if available, to prevent juices from dripping on other foods in your refrigerator. Don't buy unpackaged products from the deli if they are in contact with other unpackaged raw or cooked products. At home, use a plastic cutting board with meat and poultry; it's easier to keep clean than a wooden one. Never reuse marinade.

Thaw in the refrigerator, microwave, or in cold water changed every 30 minutes. Never thaw on the kitchen counter.

Cook meat and poultry thoroughly — meat to at least 160 degrees F, and poultry to at least 180 degrees F. Using a meat thermometer is the best way to ensure that large cuts are done. Grayish color and clear juices show when patties and individual pieces are done.

—Never interrupt cooking. If you are partially cooking meat for the grill, for example, do it while the grill is heating up.

—Allow extra cooking time if your microwave is slow. Rotate foods manually in the microwave if there is no automatic rotation device. Use the temperature probe if you have one.

—Slow cookers are not advised for frozen or stuffed products.

—Oven cooking at temperatures below 325 degrees F is not recommended.

—Stuff foods immediately before cooking, and take stuffing out immediately after cooking.

—Tasting raw or partially cooked meat and poultry is unwise.

Avoid the danger zone of 40 degrees to 140 degrees F — the zone in which most bacterial agents of foodborne illness thrive. Mishandled cooked meat and poultry may pose a greater risk of foodborne illness than eating products raw.

—Serve hot foods hot. Warming devices should keep cooked foods above 140 degrees F. A meat or candy thermometer can be used to determine temperature.

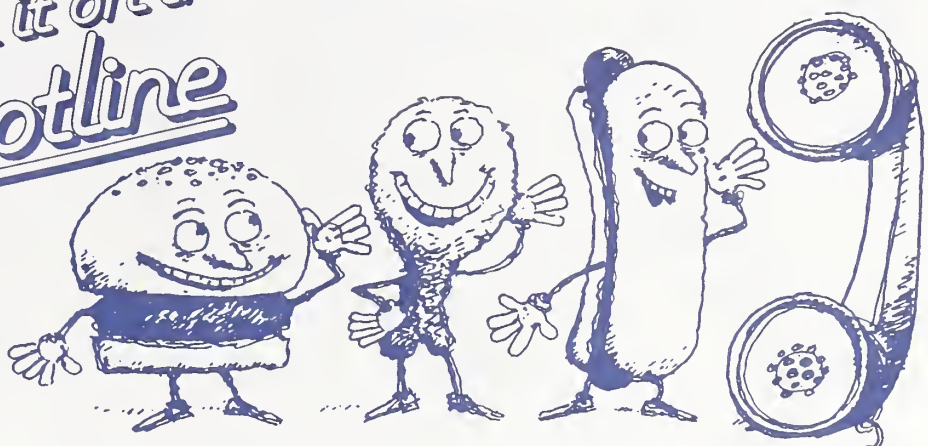
—Reheat processed products and leftovers thoroughly. "Dry" foods such as meat should be reheated to 165 degrees F. "Wet" foods such as gravy should reach a rolling boil.

Refrigerate or freeze cooked meat and poultry within 2 hours after serving — within 1 hour if it's a hot day. For rapid, even cooling, break large cuts into smaller portions; divide large casseroles into small, shallow, covered containers. Keep your refrigerator at 40 degrees F or below.

If in doubt, throw it out. Never taste foods to see if they are safe. The bacteria that cause foodborne illness don't necessarily make foods look, taste, or smell unusual. Wrap doubtful foods securely so that humans or pets can't eat them by mistake. □

Your power was off and you don't know whether the food in the refrigerator or freezer is safe? For the answers to these and other questions about food safety, call USDA's Tollfree Meat and Poultry Hotline at 1-800-535-4555. Washington, D.C., area callers may dial 447-3333. Both numbers are accessible by Telecommunications Devices for the Deaf. A USDA home economist will personally answer your questions between 10 a.m. and 4 p.m. EST.

Heard it on the Hotline



To hear the latest food safety information, call USDA's Meat and Poultry Hotline

1-800-535-4555

10:00 am–4:00 pm
Eastern Time
(Washington, DC 447-3333)

Professional home economists will answer your questions about proper handling of meat and poultry, how to tell if it is safe to eat, and how to better understand meat and poultry labels.

A public service of this publication and the U.S. Department of Agriculture